(12) UK Patent Application (19) GB (11) 2 016 368 A

(21) Application No 7908096
(22) Date of filing
7 Mar 1979
(23) Claims filed
7 Mar 1979
(30) Priority data
(31) 7808058
(32) 10 Mar 1978
(33) France (FR)
(43) Application published
26 Sep 1979
(51) INT CL^2 B32B 5/02 // 5/26
(52) Domestic classification
B5N 0512 0526
(56) Documents cited
GB 1514224
GB 1364076
GB 1310355
GB 1254850
GB 997853
GB 815910
GB 784318
GB 580851
(58) Field of search
B5N

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(54) Method of making a sailmaking fabric

(57) A sailmaking fabric is assembled from two superposed woven fabric layers such that the warp and weft of one lie at an angle to the warp and weft, respectively, of the other. The two layers are flexibly fixed together by adhesive and permanently held in place by stitch seaming into the sail sheet.

FIG.3

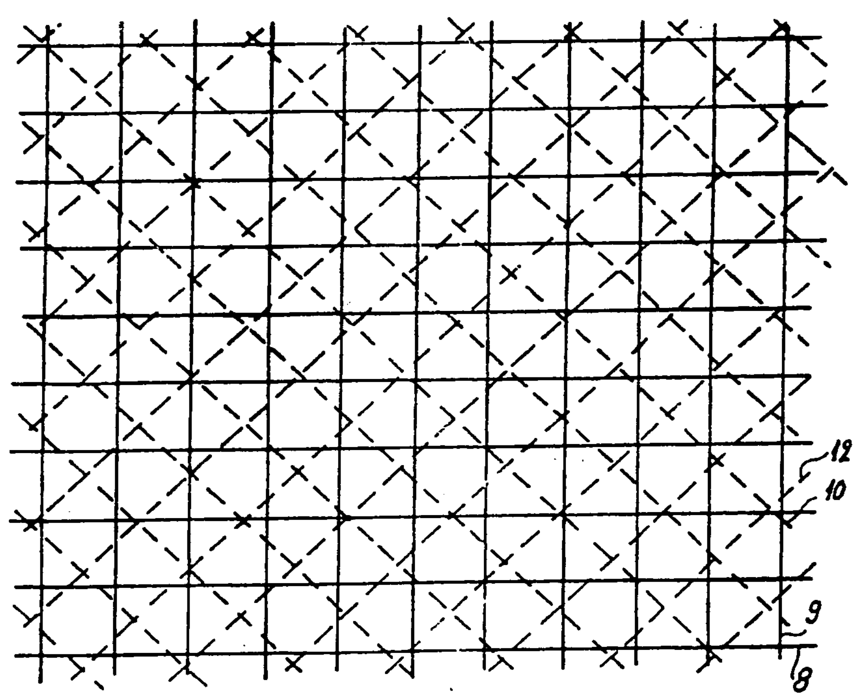

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FIG.1

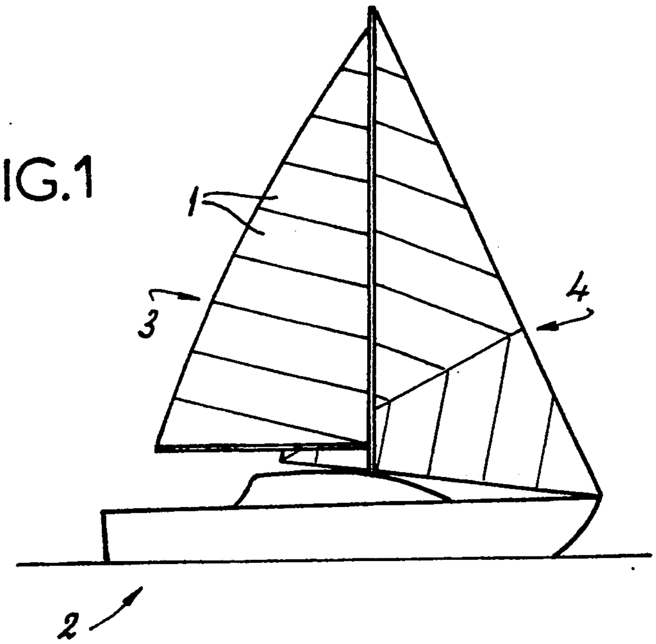


FIG.3

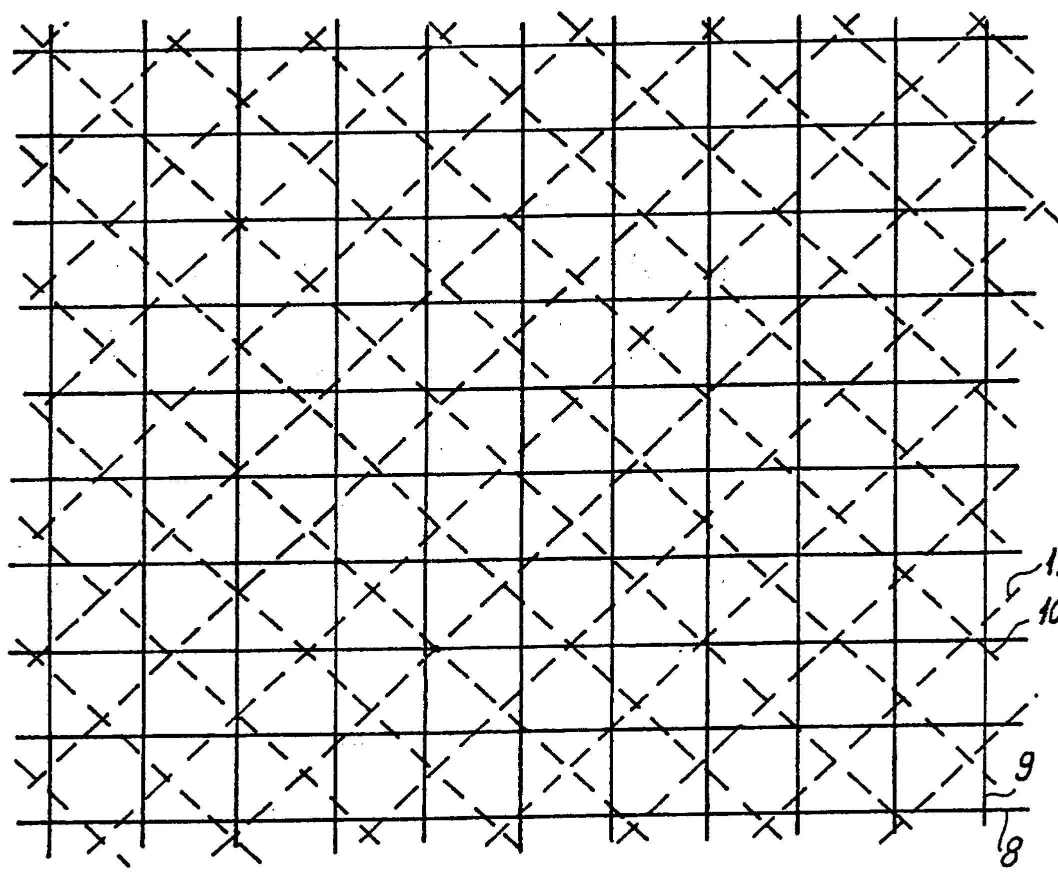


FIG. 2

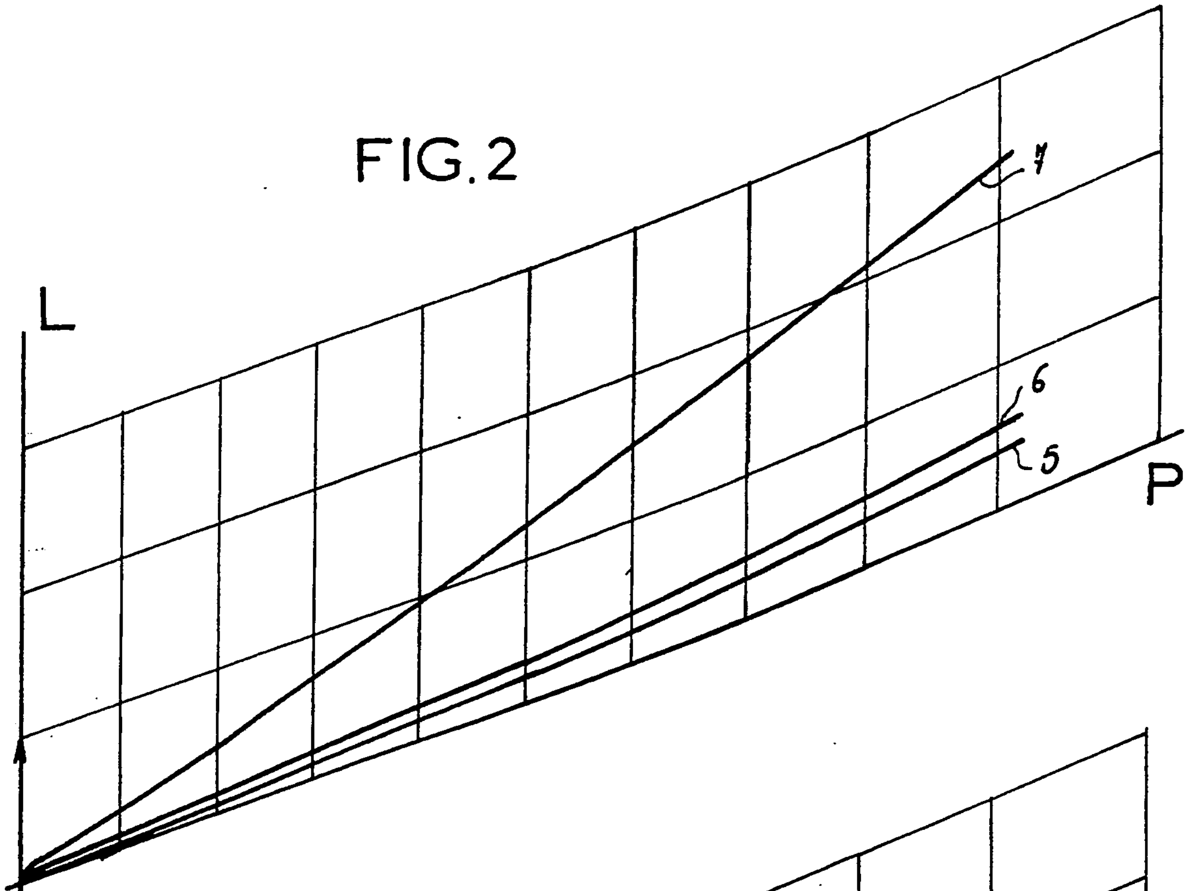
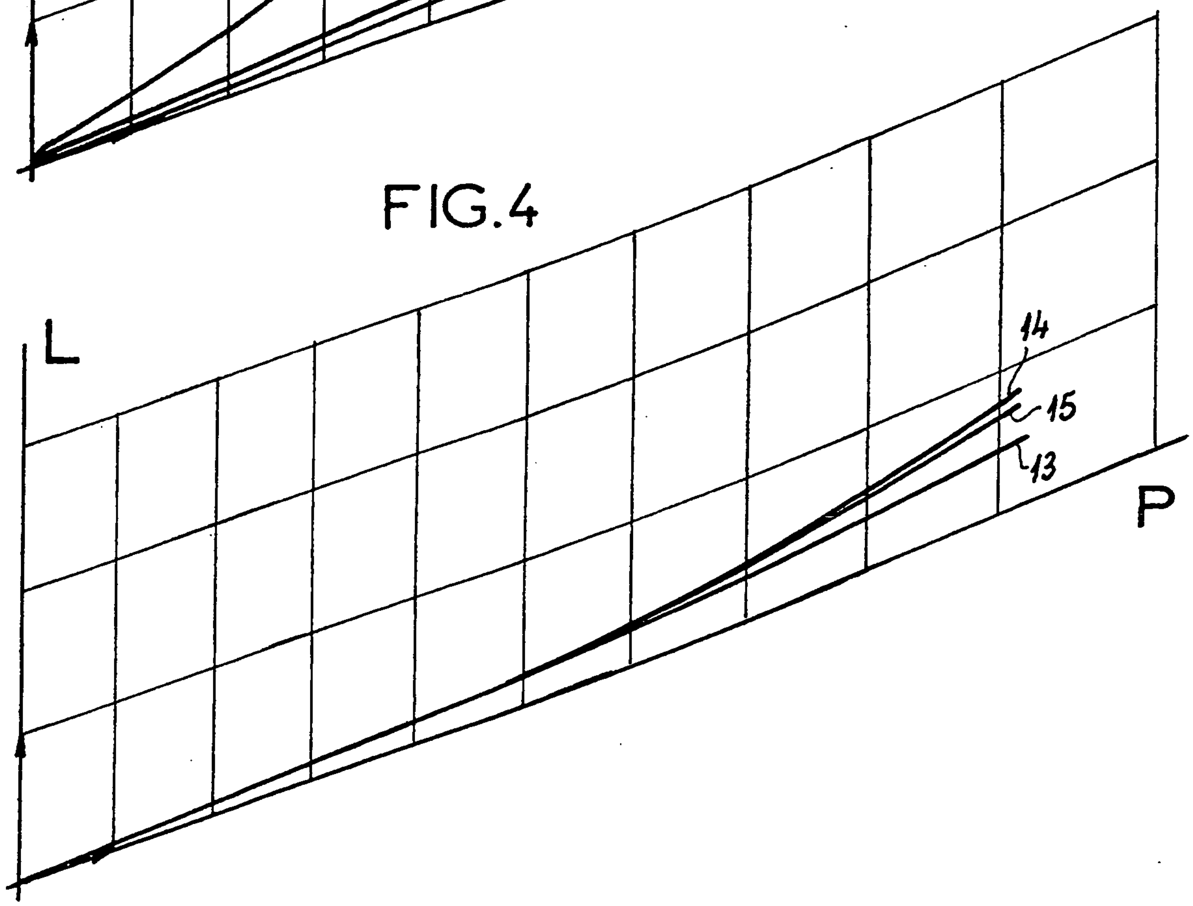


FIG. 4



SPECIFICATION

Method of making a sailmaking fabric

The present invention relates to a method of making sail fabric.

A sailmaking fabric, as this term is used hereinafter and in the claims, will be understood to be a fabric structure, usually a strip, adapted to be attached to like fabric structures in the assembly of boat sails by lateral stitch seams.

Boat sails, in recent years, generally have been fabricated from so-called synthetic fabrics, i.e. fabrics woven from threads made from synthetic-resin filaments. In the usual technique, a synthetic fabric is cut into or made available in strips which are laterally seamed together by a sewing operation carried out by the sail master. The technique is used for substantially all sailboat sails including, for example, the mainsail and the genoese jib.

The sail fabric utilized for this purpose is generally two-dimensional sheet woven from a warp and weft of various textures permitting a blocking of the threads so as to avoid all deformation of the sheet involving relative movement of the threads by the mechanical action of the wind.

Such fabrics use threads with high mechanical strength, resistance to elongation and reduced deformation under the action of the wind.

For example, the threads can be thermally shrinkable to lock them in place and fix the texture. Excellent results are obtained with polyester threads. While these conventional sail making fabrics possess the desirable properties mentioned above and thus have a low deformation coefficient in the warp and weft directions, this is not the case in the bias direction.

As will be discussed in greater detail below, the deformation under wind pressure in the weft and warp directions is relatively small while deformation in the bias direction is significantly greater for the earlier synthetic sailmaking fabrics.

Various efforts have been made to overcome this disadvantage without noticeable success.

Thus mention may be made of efforts to create a three-dimensional weave which were never realized on an industrial scale. It has also been proposed to make a double-canvas weave and to laminate two thicknesses of identical fabric with parallel weft and warp directions.

None of these approaches has been found to be economical or of satisfactory mechanical performance, i.e. to have low deformation in warp and weft direction as well as in a bias direction (at an angle of 30° to 60° to the warp and weft), low wettability, low air permeability and a satisfactory coefficient of friction relative to air.

It is an object of the invention to provide an improved and economical process for making a sail fabric which will have the desired mechanical properties enumerated above but which is free from the drawbacks of earlier fabrics.

This object is achieved in accordance with the invention, by superposing two fabric layers each formed with orthogonal arrays of weft and warp yarns so that the weft and warp directions of one layer form an angle with the weft and warp directions of the other and are directed along the bias of the latter.

In order to obtain a sail fabric of the given thickness (weight per unit area) it suffices to use two layers of lesser thickness (weight per unit area) which together add up to the desired thickness of the sail fabric.

The two coextensive layers are flexibly connected together, e.g. by adhesive bonding, upon superposition and then are permanently connected by peripheral stitching, e.g. in sewing the sail-fabric strips into the sail sheet.

Tests have shown that the compound fabric of the present invention has elongation (deformation) in the traditional weft and warp directions which is no greater than those of conventional sail fabrics of the same yarn and the same thickness (weight per unit area), while the deformation in the traditional bias direction is substantially the same as that in the weft and warp directions.

One of the fabric layers is preferably formed by flat weaving while the other is preferably formed by tubular weaving. The latter layer is then cut out of the tubular woven product by cutting along a circular helix.

The pitch of the circular helix cut is between 30° and 60° depending upon the orientation of the bias direction selected by the sailmaster for the particular piece of sailmaking fabric to be made.

Preferably, the two layers are initially flexibly interconnected by a glue or adhesive using conventional techniques in the production of bonded fabrics with the ultimate connection being *via* the stitch seams upon assembly of the sail sheet by sewing the strips together.

It should be noted that the adhesive bond between the two textile layers does not need to be permanent and indeed need only be sufficient to retain the layers in place for the sewing operations. In practice it is found that it is the stitch seams which retain the two textile layers of each section of the sail in place during long term use of the sail and not the adhesive.

An embodiment of the present invention will now be described, by way of example, with references to Figs. 1, 3 and 4 of the accompanying drawings, in which:

Figure 1 is a diagrammatic view of a sailboat equipped with sails using sail fabrics

which can be made by the method of the present invention;

Figure 2 is a graph showing the relationship between elongation and wind pressure for sail fabrics of conventional type;

Figure 3 is a diagram illustrating the sail fabric of the present invention; and

Figure 4 is a graph similar to Fig. 2 but illustrating the results obtained with the sail fabric according to the present invention.

In Fig. 1 there is shown a sailboat 2 which is equipped with two sails formed from the composite strips of the present invention or, for that matter, sailmaking fabric of the prior art. The sailboat 2 has the usual hull 2*a* with a transom 2*b* and a mast 2*c*. As has been diagrammatically illustrated, the mast 2*c* carries a mainsail 3 and a Genoese jib 4, each of which may be composed of a plurality of strips 1 of sail fabric stitched together along seams 1*a* and provided with bound edges by stitching at 1*b*, 1*c*, respectively. The orientation of the seams 1*a* is, of course, a matter to be determined by the sailmaster.

When a sail fabric of prior art type is used for the strips 1, the deformation in the warp, weft and bias direction corresponds to that given in Fig. 2. In this figure, the elongation (deformation) has been shown by plotting the dimension L along the ordinate as a function of wind pressure P plotted along the abscissa.

The curve 5 corresponds to the deformation in the weft direction while curve 6 represents the deformation in the warp direction and curve 7 the deformation in the bias direction. As has been described previously the prior art fabrics have deformation which in the warp and weft directions differ relatively little from one another and which are themselves relatively slight. However, the deformation in the bias direction is significantly greater.

Fig. 3 shows, diagrammatically, the composite fabric of the present invention which is made up of two layers of co-extensive fabrics with mutually inclined orientations of the weft and warp directions and including a flat bed weave and a tubular but helically cut weave respectively. The fabric layer represented by solid lines is shown to have a warp 8 and a weft 9 and two overlying woven fabrics represented in broken lines whose warp and weft have been indicated respectively at 10 and 11.

The two layers are temporarily bonded together by flexible adhesive, which can be any adhesive used for bonding in the formation of bonded fabrics in the garment art, the permanent attachment of the two layers together being effected by the stitch seams around their perimeter as shown at 1*a*-1*c* in Fig. 1 upon assembly of the compound fabric into the sailsheet.

The following specific example has been found especially effective for th purpose of the present invention.

A composite fabric is made with a thickness corresponding to 370 grams per m^2 by superposing two woven fabrics.

The flat bed woven fabric has the following structure:

Fabric structure:
Number of yarns: 56 × 35
Warp: polyester: 156 decitex/27 filaments/300 turns
Set up:
Combing: 19 teeth to the cm at 3 yarns/1
Drawing out: 2112 teeth to 3 yarns/1 on 8 blades
Comb width: 117 cm
Reduction: 37 strokes to the cm
Armure: taffetas

The tubular fabric has the following characteristics:

Fabric structure:
No. of yarns: 56 × 35
Warp: polyester: 156 decitex/27 filaments/300 turns
Weft: polyester: 156 decitex/27 filaments/0 turns
Set up:
Combing: 19 teeth to the cm to 6 yarns/1
Drawing out: 1500 teeth to 6 yarns/1 on 16 blades
Comb width: 83 cm
Reduction: 74 strokes to the cm
Armure: tubular

The flat weave layer is subjected to the following conventional fabric treatments:

desizing on a jigger at 80°C
bleaching on a jigger at 100°C
continuous drying on a drum at 170°C
impregnation with resin and hot flue polymerization thereof at 200°C.

The foregoing treatment also results in a shrinkage of the fabric and a fixing of its structure as well as a permanent attachment of the impregnating resin.

The temperatures may be varied depending upon the resin employed and upon the qualities which are sought from such treatments.

The fabric web is based over a drum or through a forming station at 240°C to terminate the shrinkage and improve the flatness.

The web is calendared at 190°C to flatten the fabric and improve its sliding friction characteristics.

The tubular-weave layer is subjected to the following treatments:

desizing on a jigger at 80°C;
bleaching on a jigger at 100°C;
continuous drum drying at 170 C;
resin impregnation and polymerization by the hot flue proc ss at 200°C;

This treatment also causes shrinkage of the fabric and a setting of the structure as well as a permanent bonding of the impregnating resin.

Here also the temperature can be adjusted in accordance with the resins employed and the qualities which are sought by the treat-

ments.

The tubular-weave fabric is cut in the following manner:

The tube is opened by a guide system having three fingers and a jet of air directed along the axis of the fingers. The tube is guided by these fingers at an angle of 45° (in the case of a cut at a pitch of 45°) with respect to the direction in which the fabric is drawn. The cut is effected by a cutting wheel rotated at high speed and perpendicular to the draw of the fabric. The fabric is drawn over the fingers by a system of three rollers with tangential drive. The driving structure may rotate with the tubular web to avoid tearing the same.

The cut-open tube is then calendared on a precision calendaring machine at 190°C to flatten the fabric and improve its coefficient of friction and planarity.

The two fabrics, in coextensive relation, are then assembled by adhesive with a flexible and elastic bond between them. In practice the adhesive is applied to the flat weave fabric and the two fabrics are then pressed together by calendaring. The resulting complex is then cut to the desired size and permanently bonded together by hot cutting rollers or ultrasonic seam formation along the periphery with the strippling being marked as to proximity to the edge for ultimate assembly of the sail. In the sail, the seam which secures the strip in place also forms the permanent bond for the tube layers.

The complex fabric is that which has been represented in Fig. 3 diagrammatically in which the warp and weft directions 8, 9 of the flat-weave fabric form an angle of 45° with the warp and weft directions 10 and 12 of the tubular fabric.

The mechanical properties of this fabric have been given in Fig. 4 in which, as in Fig. 2, the deformation is plotted along the ordinate against the pressure plotted along the abscissa.

By contrast with the results described in connection with Fig. 2 as to the prior art, the warp deformation 13 (measured along the warp of the flat weave) is close to the weft deformation but the bias deformation 15 is practically identical to the deformation in the warp and weft directions and is practically as negligible as these.

CLAIMS

1. A process for producing a sailmaking fabric which comprises the steps of superposing a first woven fabric layer on a second woven fabric layer such that the warp and weft directions of the first layer lie along the bias of the second layer and securing said layers together, thereby forming a composite whose elongation under pressure is practically the same in the warp, weft and bias directions.

2. A process according to Claim 1 wherein said first layer is formed by flat weaving and said second layer is formed by tubular weaving and cutting the resulting tube along the circular helix.

3. A process according to Claim 2 wherein said circular helix has a pitch between 30° and 60°.

4. A process according to Claim 3 wherein said circular helix has a pitch of about 45°.

5. A process according to any one of Claims 1 to 4 wherein said layers are initially bonded together by a flexible adhesive and are thereafter permanently secured together by stitching.

6. A process according to any one of Claims 1 to 5 wherein both of said layers are composed of polyester yarns.

7. A process according to any one of Claims 1 to 6 wherein both of said layers have the same weft and warp thread numbers.

8. A sailmaking fabric having a pair of coextensive fabric layers permanently affixed together and having warp, weft and bias deformations under pressure which are substantially the same, said fabric being made by the process according to any one of Claims 1 to 7.

9. A sail comprises a plurality of strips of the sailmaking fabric according to Claim 8 connected together by respective stitch seams.

10. A process for producing a sailmaking fabric, substantially as hereinbefore described with reference to Figs. 1, 3 and 4 of the accompanying drawings.

Printed for Her Majesty's Stationery Office by Burgess & Son (Abingdon) Ltd.—1979.
Published at The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.